Jackson River Benthic TMDL Development

Stressor Identification

Public Meeting #2

Covington , Virginia

November 10, 2005

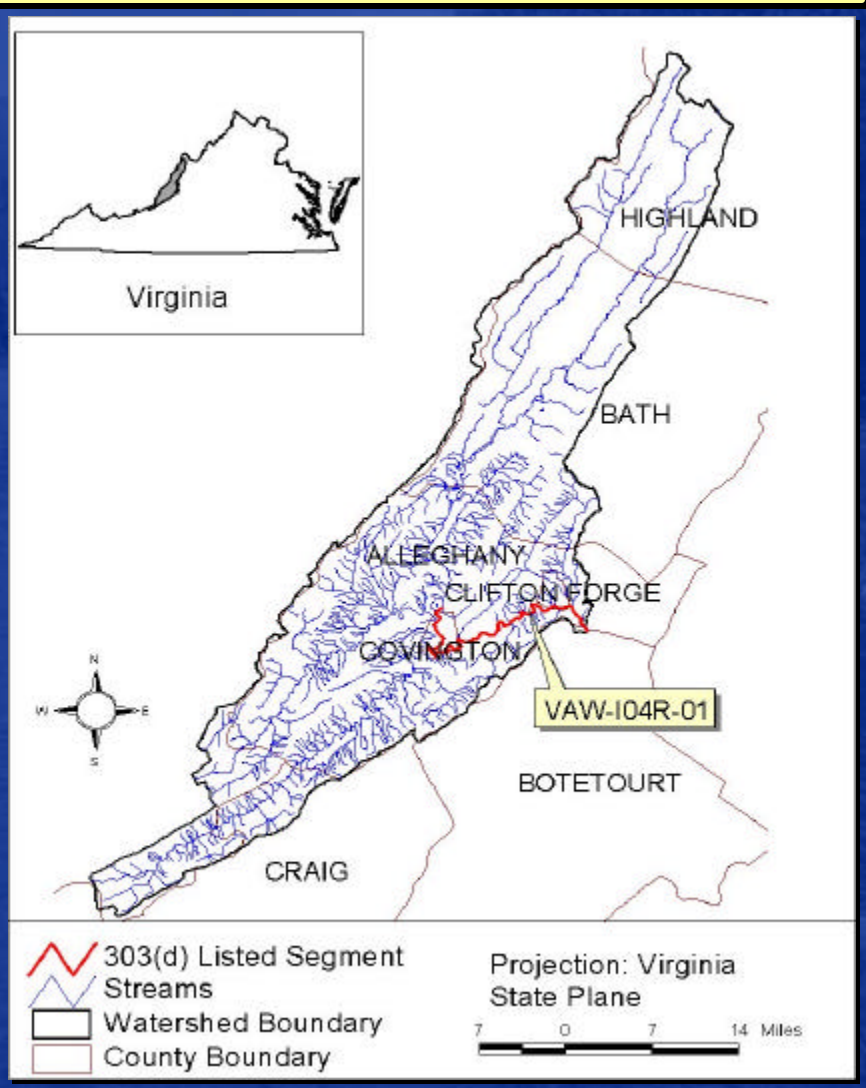
THE Louis Berger Group, INC.

Agenda

- Present the impaired segment
- Describe the benthic TMDL process
- Present environmental data
- Present draft stressor identification
- Describe next steps

Jackson River Listed Segment

- **Segment VAW-I04R-01**
  - Listed on the 1996, 1998, 2002, 2004 Section 303(d) Lists of Impaired Waters (VADEQ)
- **Upstream Limit:**
  - Immediately below the Covington City Water Treatment Plant intake
  - 24.21 River Mile
- **Downstream Limit**
  - Confluence of the Jackson and Cowpasture Rivers
  - 00.00 River Mile

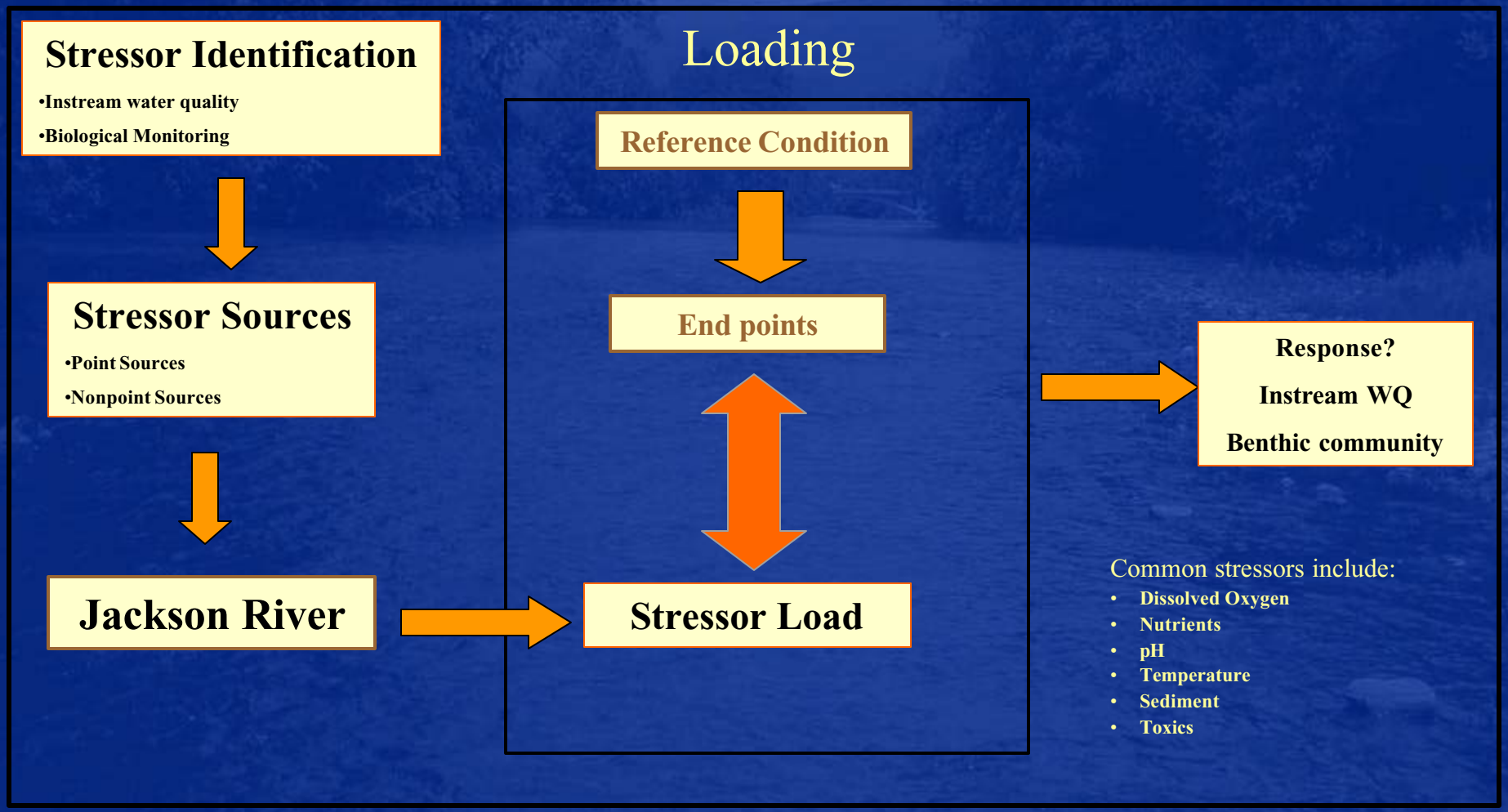


Benthic Impairment

- **Based on Biological Monitoring**
  - Assessments indicate the benthic community is impaired.
  - Therefore, the listed segment does not meet the Aquatic Life Use support goal.

The General Water Quality Standard: "All state waters shall be free from substances […] which are harmful to human, animal, plant or aquatic life." (9 VAC 25-260-20).

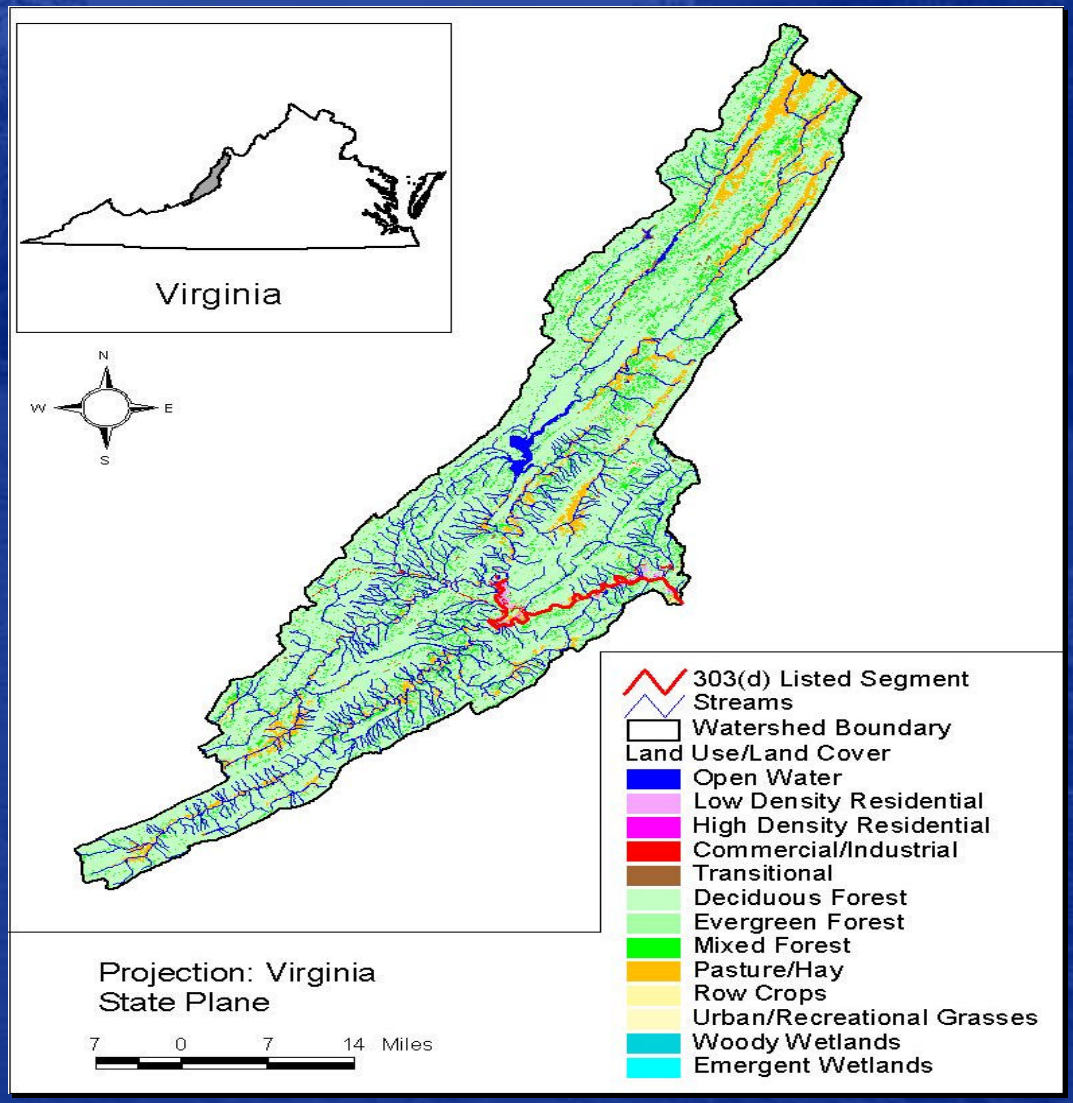
TMDL Process for Benthic Impairment



Watershed Characterization

Land Use in the Jackson River

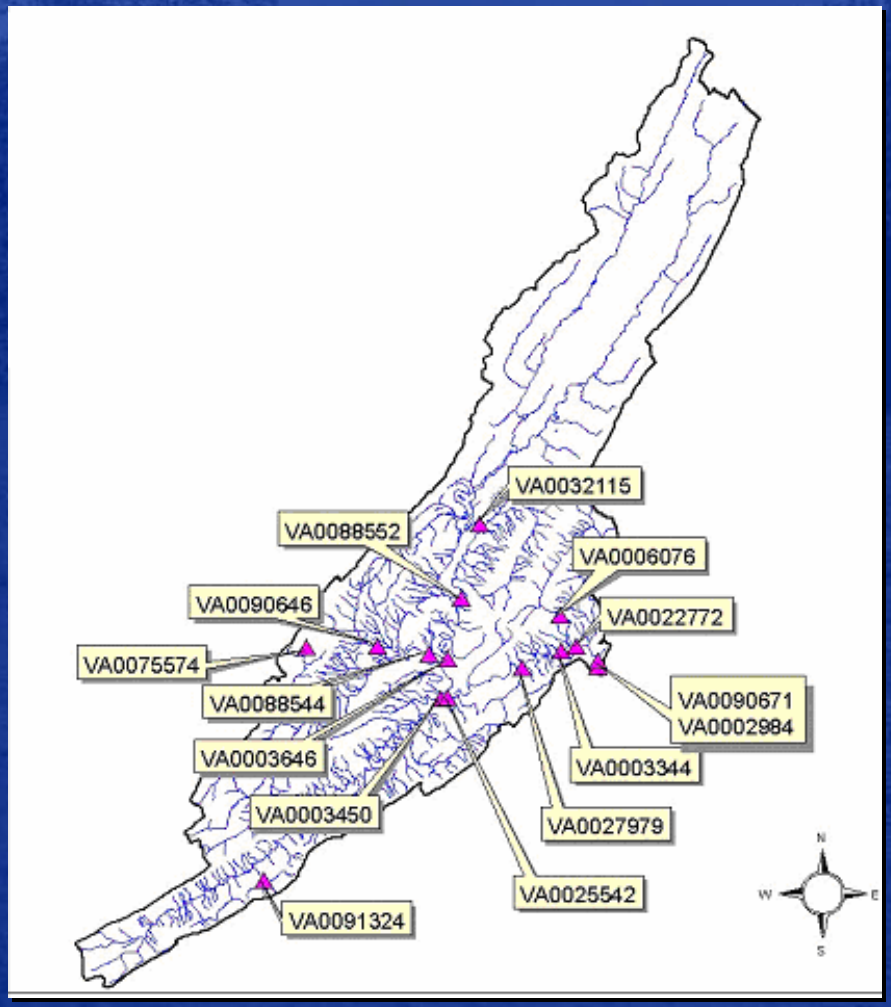
- Watershed Area
  - 584,686 acres
- Dominant land uses
  - 89.3% Forested
  - 8.5% Agriculture
  - 0.9% Developed



Permitted Facilities in the in Watershed

- **33 Active Permits:**
  - 15 permits issued to industrial and municipal facilities
  - 11 stormwater permits issued to industrial facilities
  - 2 permits issued to mines
  - 3 permits issued to domestic sewage facilities
  - 1 stormwater permit issued to construction sites
  - 1 permit issued to a concrete facility

Permitted Facilities



Benthic Stressor Identification

- **What pollutant(s) is causing the impairment of the benthic community?**
- **Common stressors include:**
  - Dissolved Oxygen
  - Nutrients
  - pH
  - Temperature
  - Sediment
  - Toxics

Stressor Identification

- Each candidate stressor was evaluated based on available monitoring data, field observations, and consideration of potential sources in the watershed
- Potential stressors were further classified as a *non-stressor*, *possible stressor*, or *most probable stressor.*

Data Used in Stressor Identification

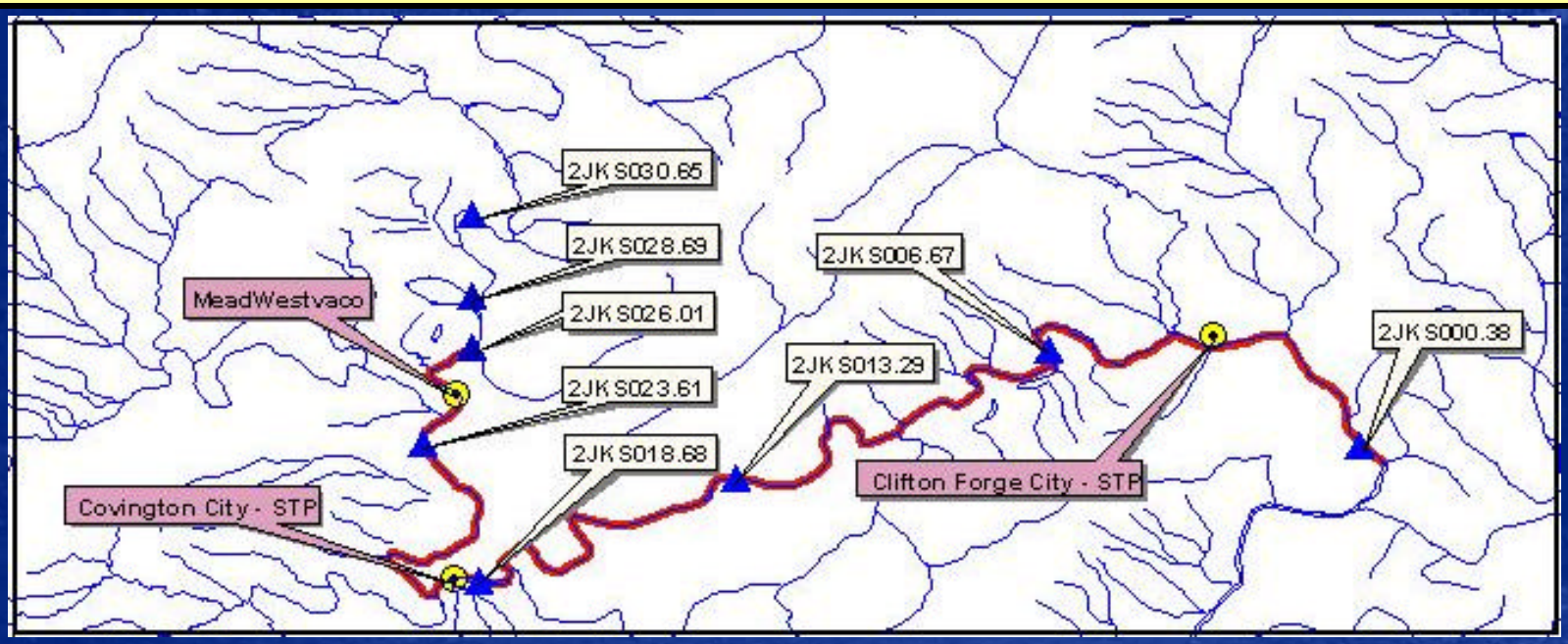
Environmental Data:

1. Instream Water Quality Data
2. Biological and Habitat Assessment Data
3. Acute and Chronic Toxicity Testing
4. Field notes and observations
5. Discharge Monitoring Reports (DMR), Nutrient Monitoring Reports (NMR), WET toxicity testing
6. Stream flow

Sources:

- **VADEQ**
  - Instream water quality data
  - Biological monitoring data
- **Mead Westvaco**
  - Instream water quality data
  - Biological monitoring data
  - Nutrient data
  - Metals data
  - Periphyton data
  - Periphyton studies conducted by Stroud Water Research Center, Patrick Center for Environmental Research

VADEQ Monitoring Stations



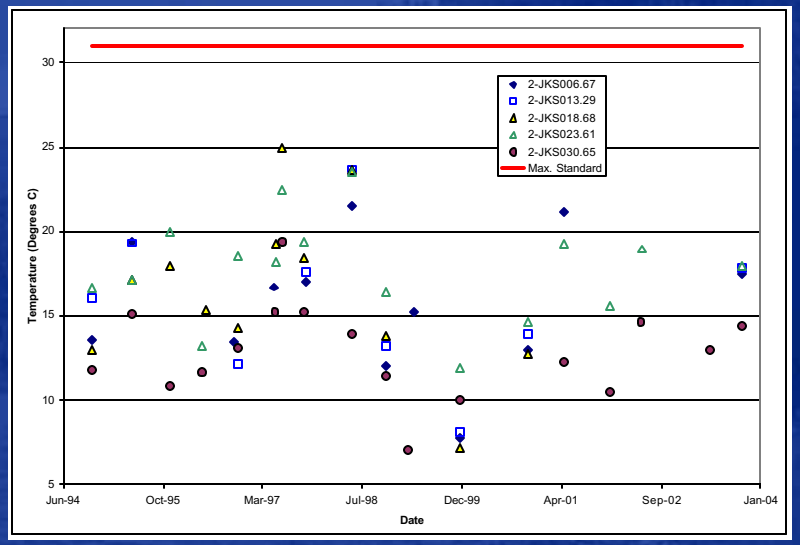
Station Id	Station Location	Period of Record	No. Sampling Events
2JKS000.38	Route 727 Iron Gate	1989-2005	4703
2JKS006.67	Low Water Bridge Near Dabney Lancaster	1989-2004	4299
2JKS013.29	Off Route 696, Above Low Moore - Alleghany	1989-2005	404
2JKS018.68	Route 18 Bridge - City of Covington	1989-2003	4049
2JKS023.61	Covington Gage City Park	1989-2005	4775
2JKS026.01	Route 687 Bridge, Clearwater Park Alleghany	2003-2005	70
2JKS028.69	North of Intervale	2004	209
2JKS030.65	Route 687 Bridge Clearwater Park Alleghany	1989-2005	2990

pH and Temperature

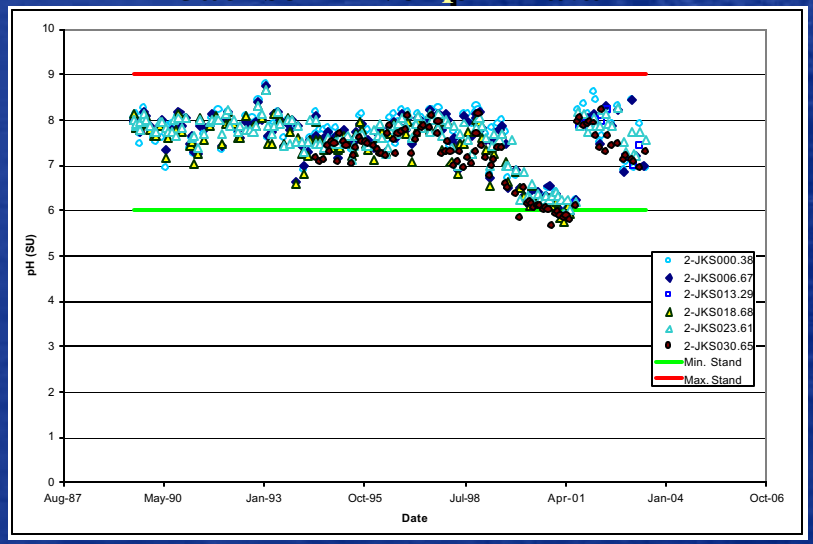
- Monitoring data indicate adequate pH and temperature values in the Jackson River

Therefore, pH and temperature are considered as non-stressors in the Jackson River

Jackson River Temperature Data



Jackson River pH Data



Metals

- DEQ water quality data indicated
  - no dissolved metals parameters exceeded Virginia's established water quality standards
  - no sediment metals exceeded the Virginia's established sediment screening value
- Metals sampled:
  - Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc

Therefore, metals are considered as non-stressors in the Jackson River

Organics

- DEQ water quality data indicated
  - no dissolved organics parameters exceeded Virginia's established water quality standards
  - no sediment organics exceeded the Virginia's established sediment screening value
- Organics sampled:
  - Chlordane, DDD, DDE, Dioxin, Endrin, Endosulfan, Heptachlor Epoxide, Total PCBs

Therefore, organics are considered as non-stressors in the Jackson River

Suspended Solids/Sediment

- Total suspended solids concentrations collected by MeadWestvaco plant indicated that the TSS solids concentrations were low across the monitoring stations.
- The Jackson River watershed is largely forested, excessive non-point source sediment loading to the river is unlikely

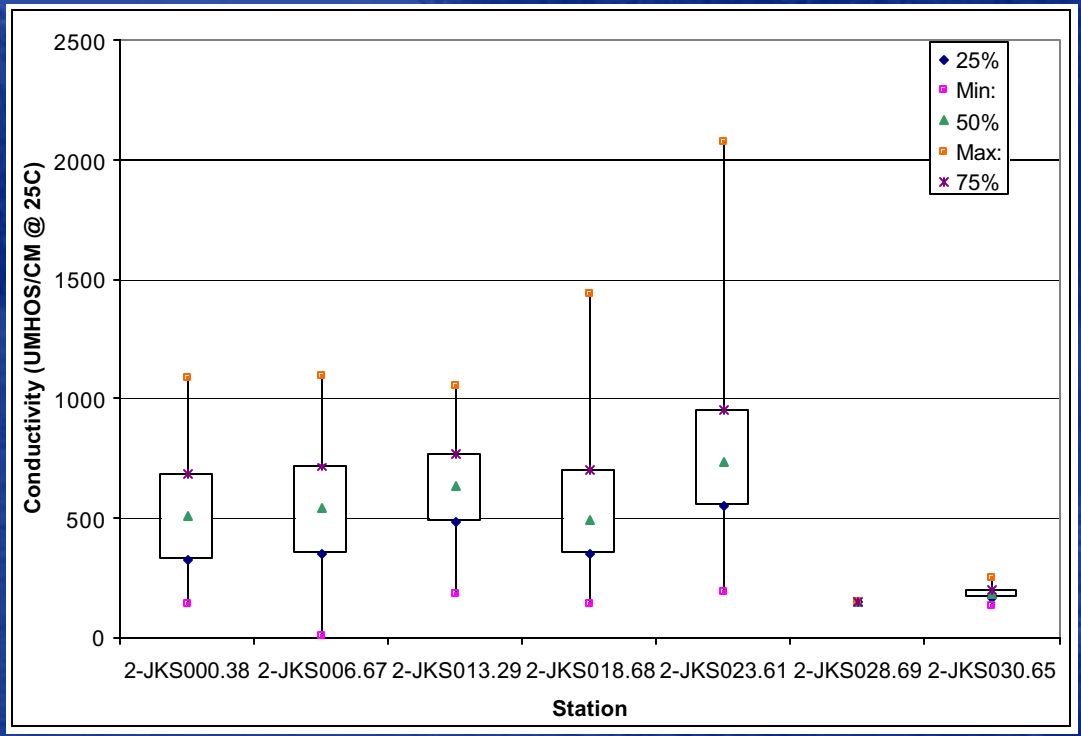
Therefore, suspended solids are considered as non-stressors in the Jackson River

Station	River Mile from Mead Westvaco Plant	Average Total Suspended Solids (mg/L)	Average Volatile Suspended Solids (mg/L)
Clearwater Bridge	-4.4	2.39	0.93
City Filtration Plant	-1.2	1.90	0.79
Mill Dam	0	3.72	1.11
Pedestrian Bridge	0.3	7.36	4.12
Dunlap Creek	0.5	2.24	0.84
Fudges Bridge	2	4.27	1.90
Hercules Bridge	3.7	6.36	2.96
Potts Creek	5.1	1.87	0.80
Idlewilde Bridge	5.9	7.47	2.31
Valley Ridge Bridge	12.6	12.49	2.30
Clifton Forge WWTP downstream	19.1	7.48	1.96

Conductivity/Total Dissolved Solids

- Field monitoring shows elevated conductivity at most of the monitoring stations
- Conductivity is commonly used as a surrogate for TDS
- Aquatic organisms are sensitive to elevated TDS concentrations

Jackson River Conductivity Data



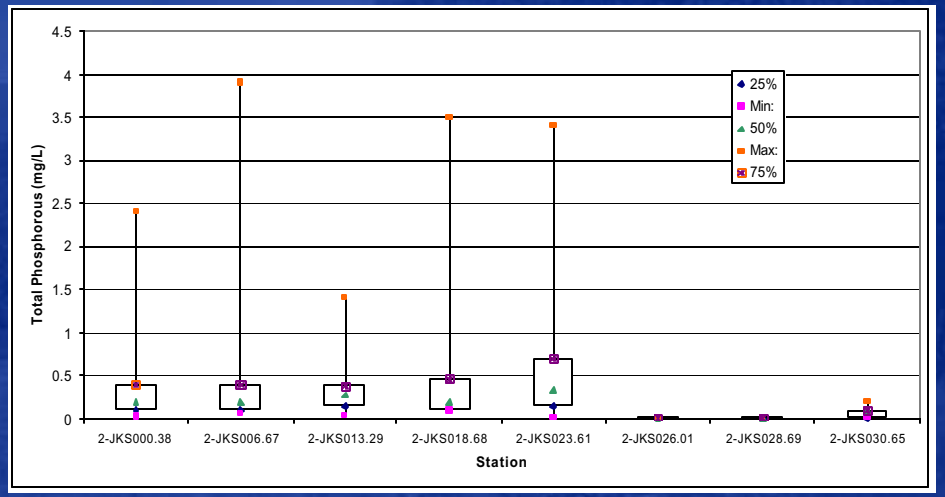
Therefore, TDS is considered as a possible stressor in the Jackson River

Phosphorous and Nitrogen

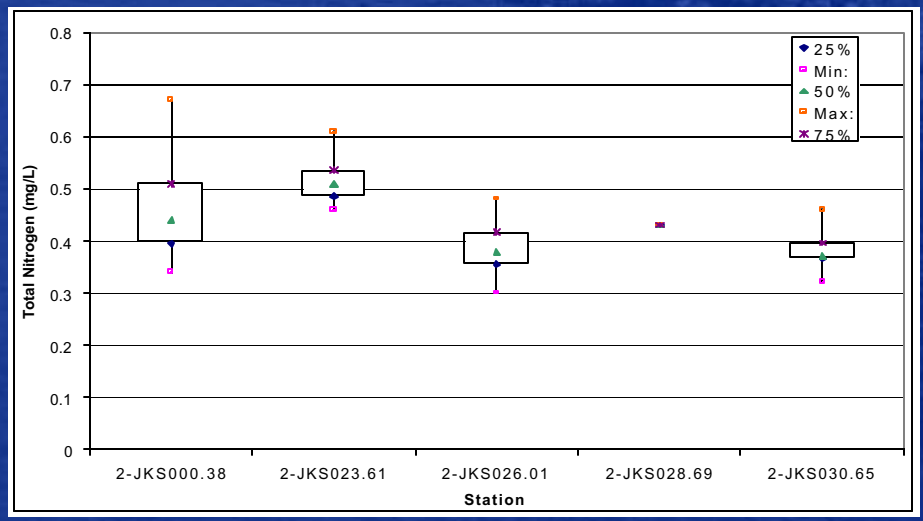
- High nutrient concentrations were observed in the Jackson River
- High nutrient concentrations appear to be resulting in significant periphyton growth
- DEQ ambient instream monitoring indicates that total phosphorus concentrations increase significantly in the Jackson River at station 2JKS023.61, below the MeadWestvaco facility and at the upstream end of the biologically impaired segment

Excessive nutrient loading leading to eutrophic conditions is considered to be a most probable stressor

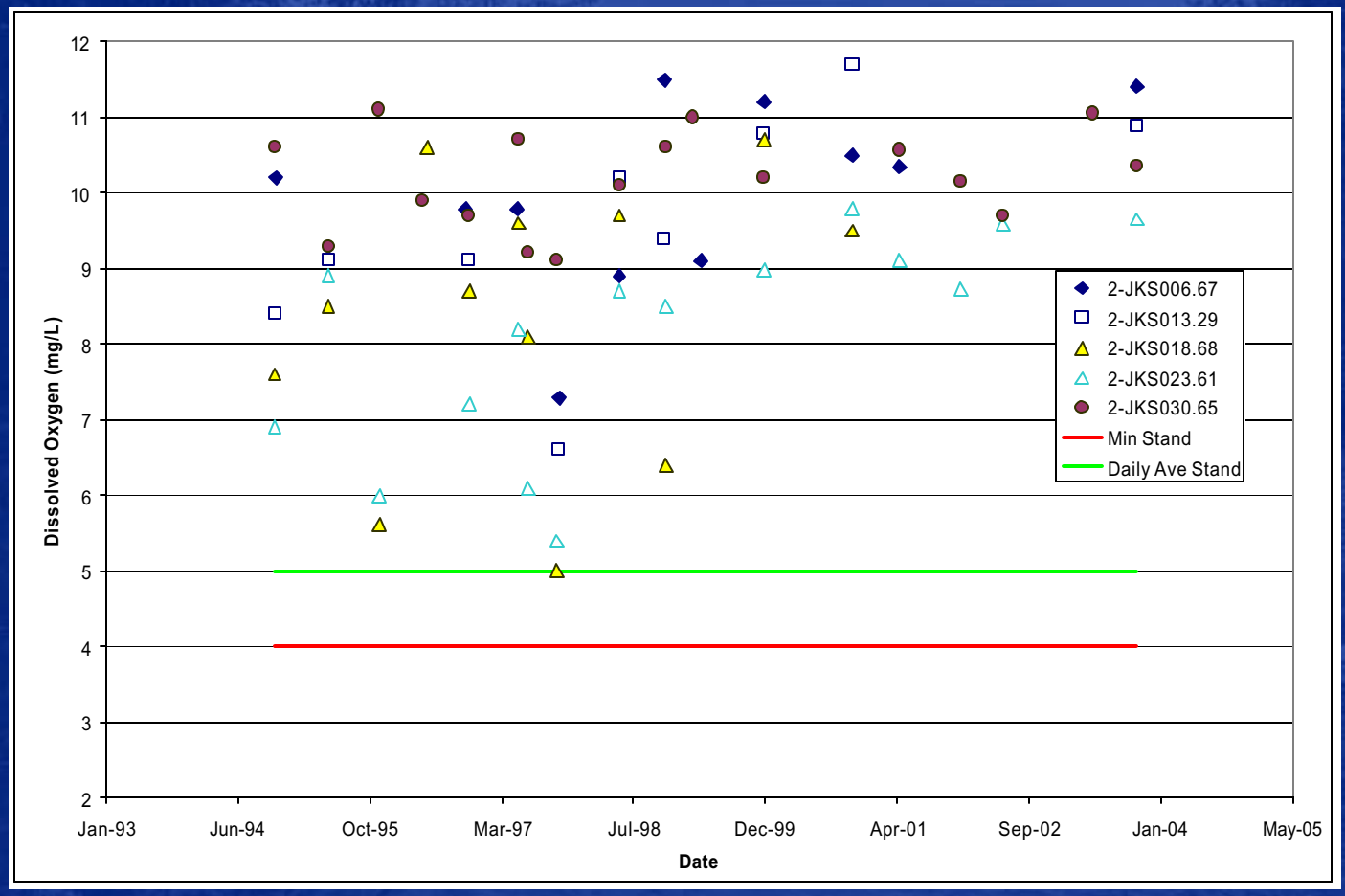
In-Stream Total Phosphorus Concentrations



In-Stream Total Nitrogen Concentrations



Dissolved Oxygen

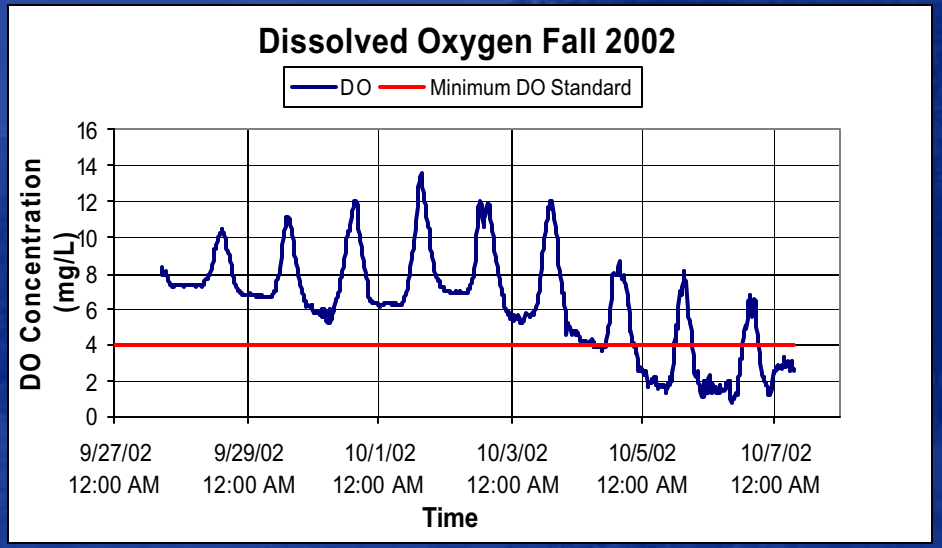


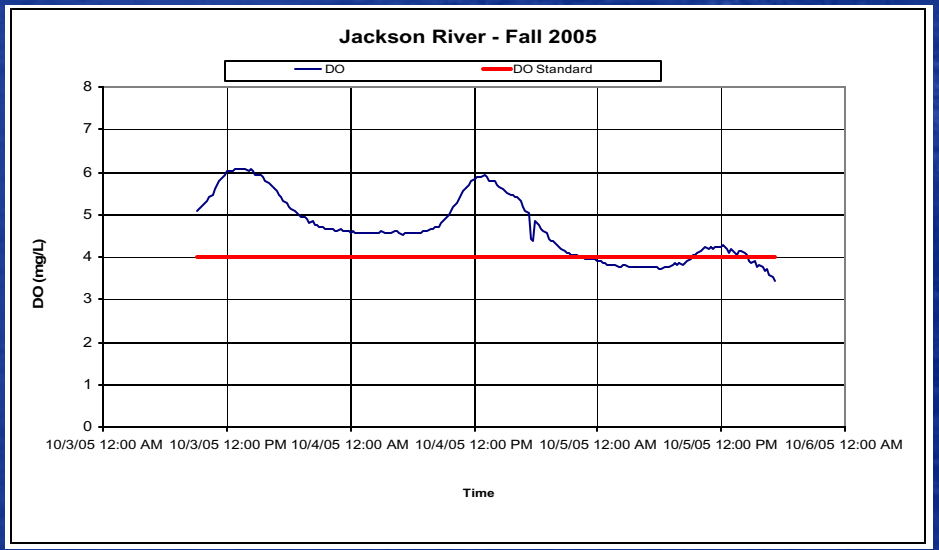
Field dissolved oxygen concentrations indicate adequate DO levels (above the standards)

Diurnal Dissolved Oxygen

- Low instream dissolved oxygen concentrations are a problem in the Jackson River
- This problem is in part the result of the excessive nutrient loading to the river and subsequent periphyton growth that occurs because of this nutrient enrichment.

Low Dissolved Oxygen conditions are considered to be a most probable stressor





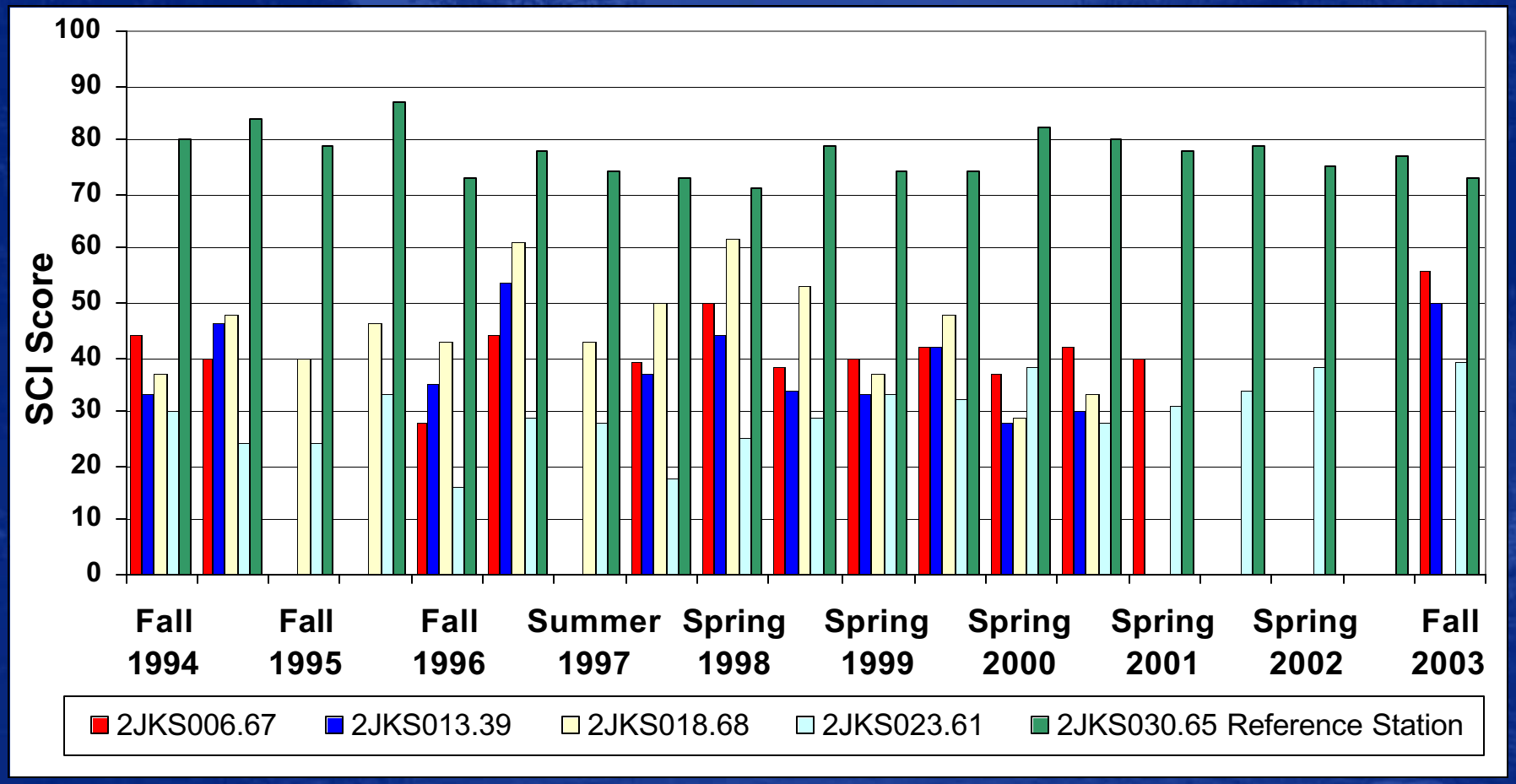
Biological Data

RBPII Assessment Scores

Reference Station 2JK030.65 has a RPBII Score of 100

Station	Year	Season	RBPII Score	Assessment
2JKS006.67	1998	Spring	47.83	Moderately Impaired
		Fall	33.33	Severely Impaired (BPJ)[1]
	1999	Spring	34.78	Severely Impaired (BPJ)
		Fall	39.13	Severely Impaired (BPJ)
	2000	Spring	21.47	Severely Impaired (BPJ)
		Fall	37.50	Moderately Impaired
	2001	Spring	29.17	Moderately Impaired
		Fall	N/A	Not Sampled
2JKS013.29	1998	Spring	30.43	Moderately Impaired
		Fall	12.50	Severely Impaired
	1999	Spring	26.09	Severely Impaired (BPJ)
		Fall	43.48	Severely Impaired (BPJ)
	2000	Spring	13.04	Severely Impaired
		Fall	16.67	Severely Impaired
2JKS018.68	1998	Spring	68.75	Moderately Impaired
		Fall	41.67	Moderately Impaired
	1999	Spring	30.43	Severely Impaired (BPJ)
		Fall	39.13	Severely Impaired (BPJ)
	2000	Spring	21.74	Severely Impaired (BPJ)
		Fall	16.67	Severely Impaired
2JKS023.61	1998	Spring	13.04	Severely Impaired
		Fall	12.50	Severely Impaired
	1999	Spring	30.43	Severely Impaired (BPJ)
		Fall	26.09	Severely Impaired (BPJ)
	2000	Spring	13.04	Severely Impaired
		Fall	8.33	Severely Impaired
	2001	Spring	12.50	Severely Impaired
		Fall	21.74	Severely Impaired (BPJ)
	2002	Spring	22.73	Severely Impaired (BPJ)
		Fall	N/A	Not Sampled

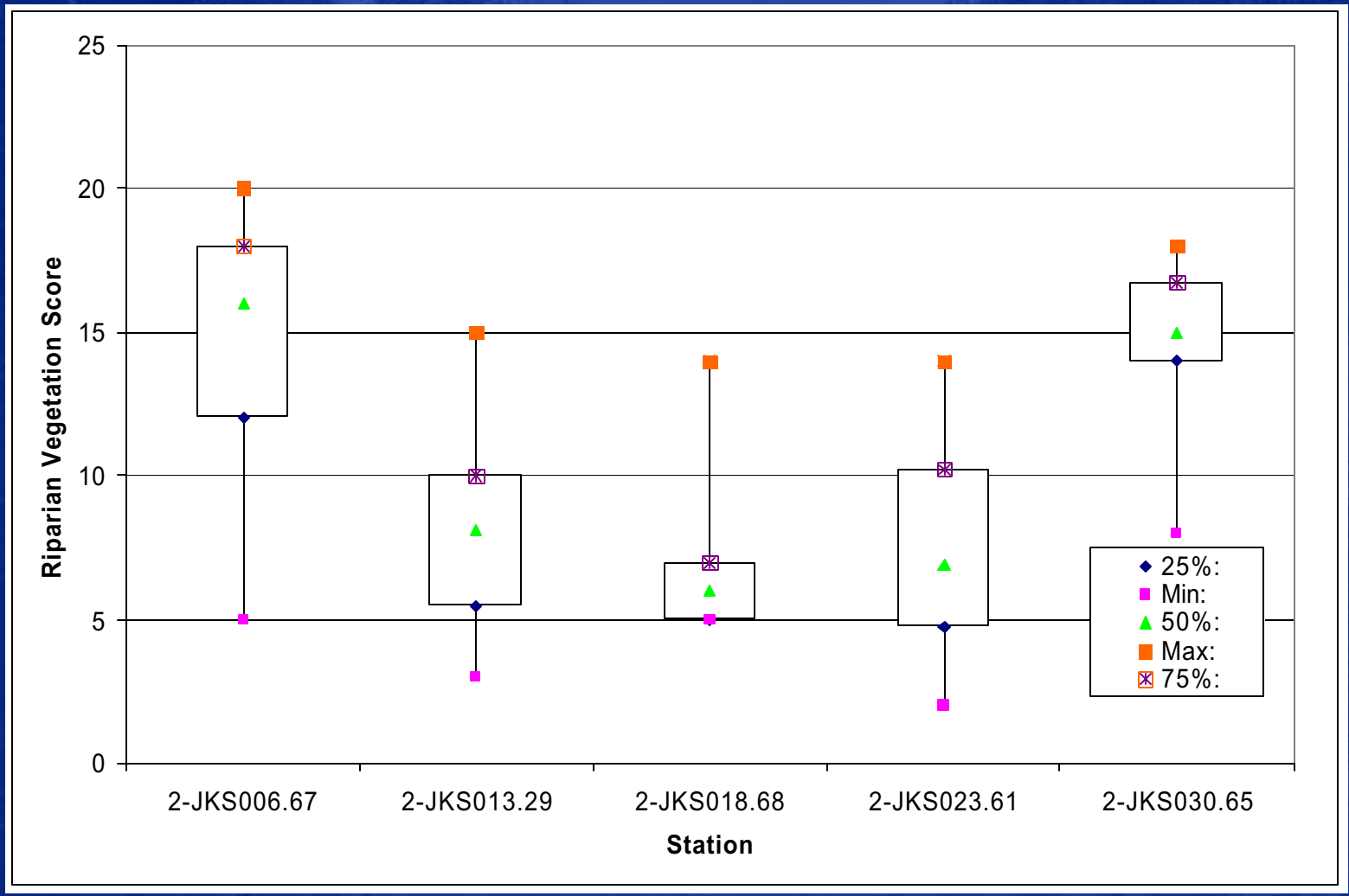
Biological Monitoring SCI Scores



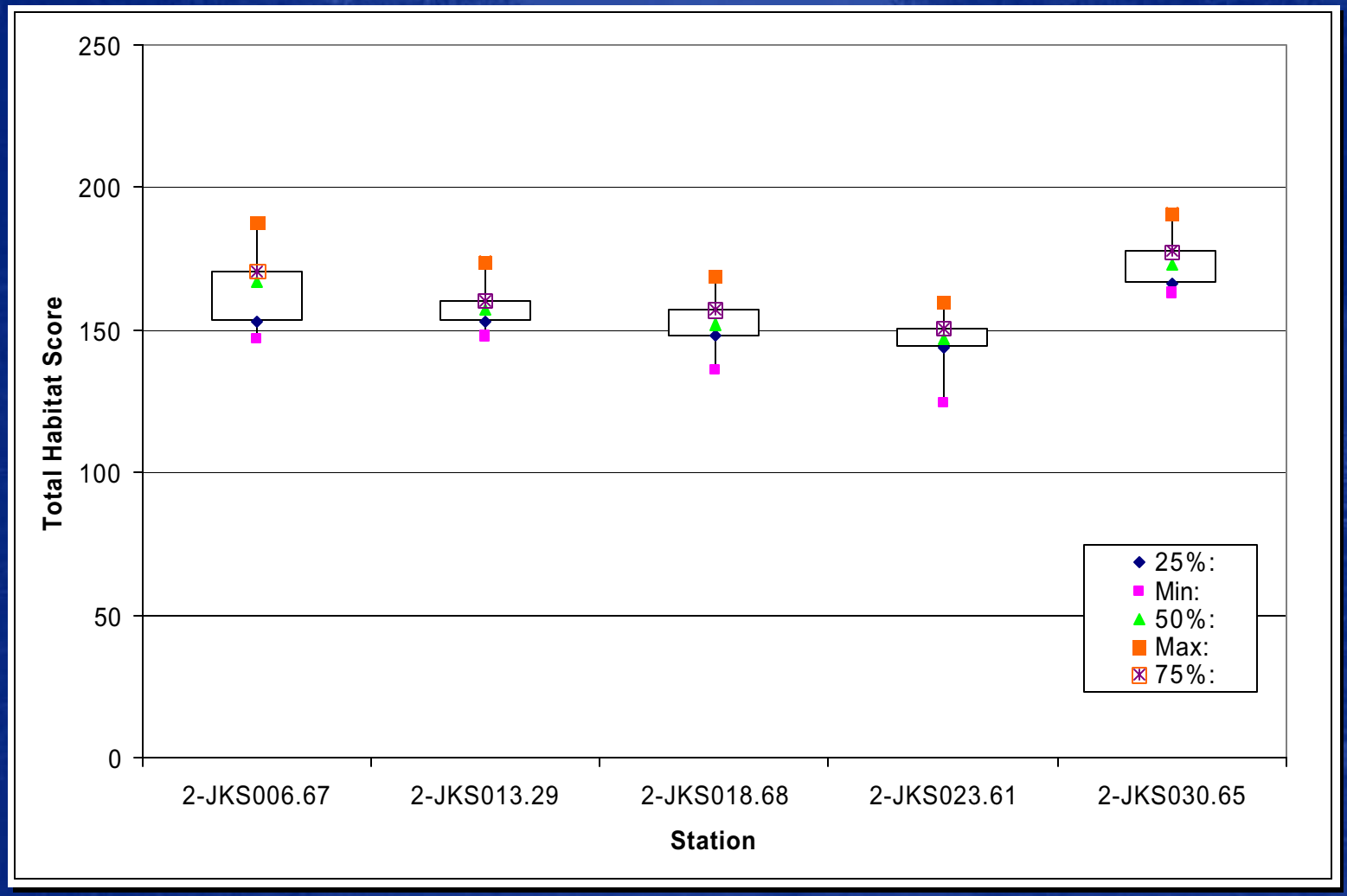
Biological Monitoring SCI Scores

Collection Period	SCI Score				
	2JKS006.67	2JKS013.29	2JKS018.68	2JKS023.61	[1]2JKS030.65
Fall 1994	44	33	37	30	80
Spring 1995	40	46	48	24	84
Fall 1995	-	-	40	24	79
Spring 1996	-	-	46	33	87
Fall 1996	28	35	43	16	73
Spring 1997	44	54	61	29	78
Summer 1997	-	-	43	28	74
Fall 1997	39	37	50	18	73
Spring 1998	50	44	62	25	71
Fall 1998	38	34	53	29	79
Spring 1999	40	33	37	33	74
Fall 1999	42	42	48	32	74
Spring 2000	37	28	29	38	82
Fall 2000	42	30	33	28	80
Spring 2001	40	-	-	31	78
Fall 2001	-	-	-	34	79
Spring 2002	-	-	-	38	75
Spring 2003	-	-	-	-	77
Fall 2003	56	50	-	39	73
Average	41.5	38.8	45.0	29.4	77.4

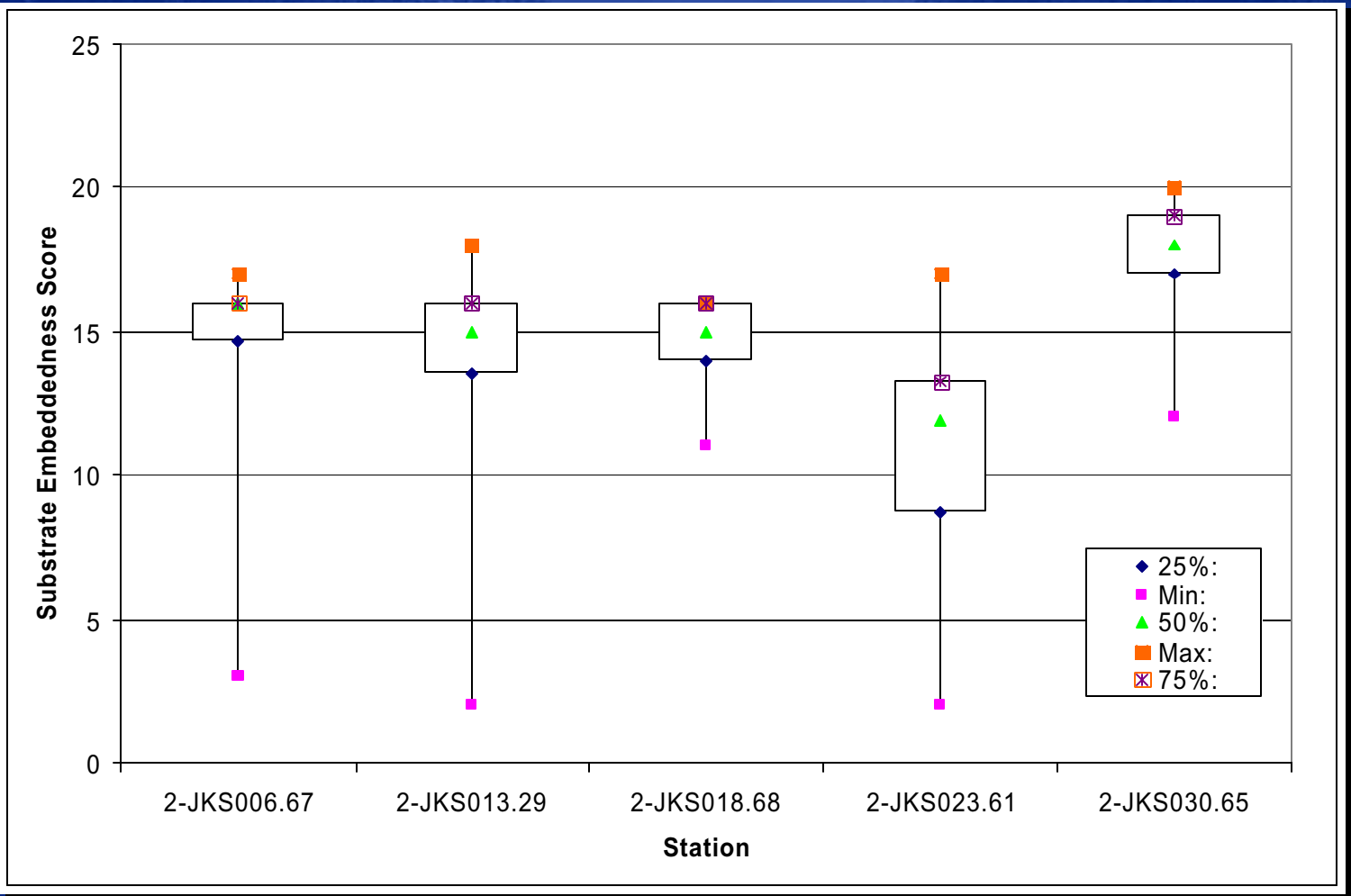
Habitat Assessment Scores: Riparian Vegetation



Habitat Assessment Scores: Total Habitat



Habitat Assessment Scores: Substrate Embeddedness



Field Observations- Periphyton Growth

Toxicity

- Acute and Chronic toxicity Testing was performed on water samples collected by DEQ in May 2005 at stations 2JKS006.67 and 2JKS023.61
- Results indicated that there were no toxic water column effects to Ceriodaphnia in the Jackson River samples
- Ranges of fathead minnow survival in samples collected at station 2JKS023.61 was between 30% to 60%, which was statistically different from the laboratory control

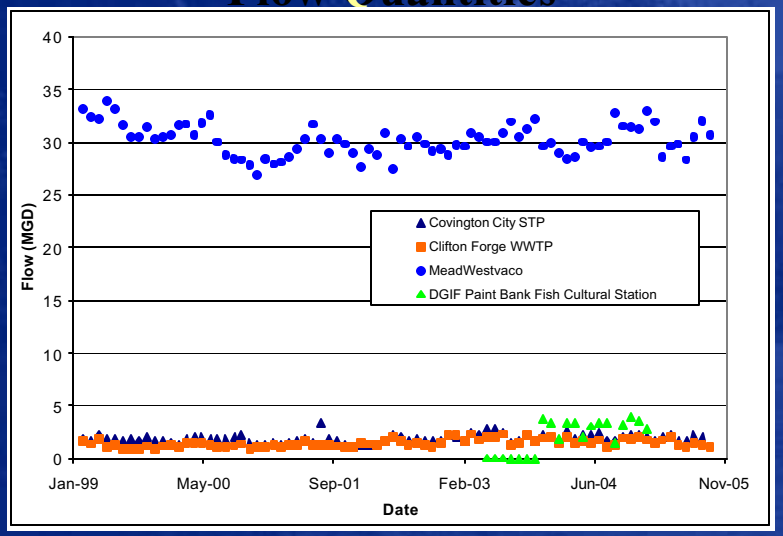
The EPA Region 3 laboratory in Wheeling indicated that in their professional judgment, these results "were probably biologically significant", and that it was necessary to compare the observed toxicity testing results with other water quality data collected at these sites to determine the presence of toxicity.

Major Facilities DMR

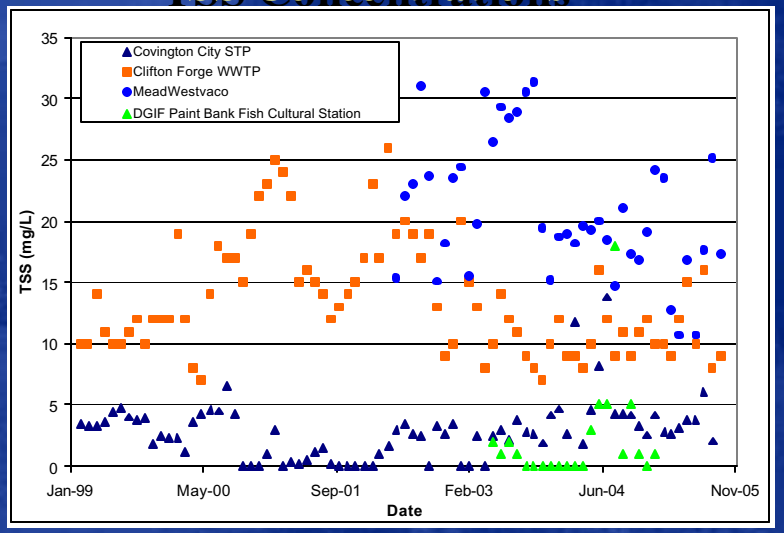
Permit Number	Facility Name (main outfall #)	Facility Type	Design Flow (MGD)[1]	Receiving Waterbody	Status
VA0022772	Clifton Forge City STP (1)	Municipal	2.0	Jackson River	Active
VA0025542	Covington City STP (1)	Municipal	3.0	Jackson River	Active
VA0091324	DGIF Paint Bank Fish Cultural Station (1)	Industrial	2.9	Paint Bank Branch	Active
VA0003646	MeadWestvaco Packaging Resource Group (3)	Industrial	32.9	Jackson River	Active
VA0090671	Alleghany Co - Lower Jackson River WWTP	Municipal	2.0	Jackson River	Inactive
1: Million Gallons per Day					

Flow, TSS, and BOD5 Concentrations from Major Dischargers

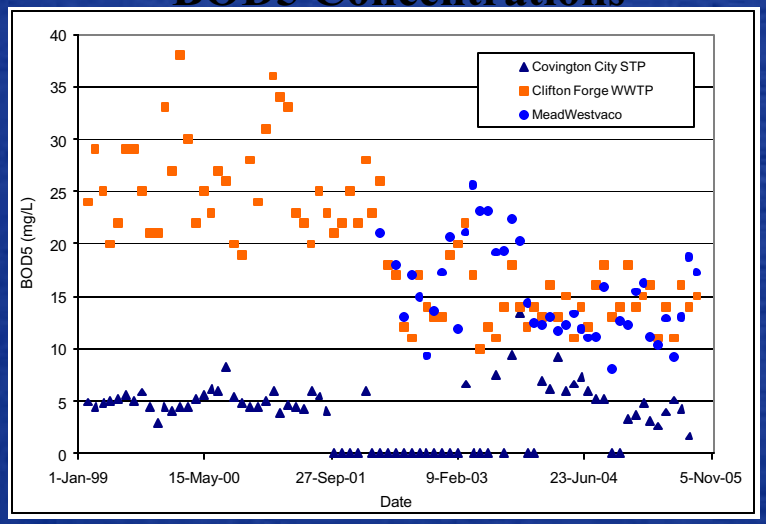
Flow Quantities



TSS Concentrations



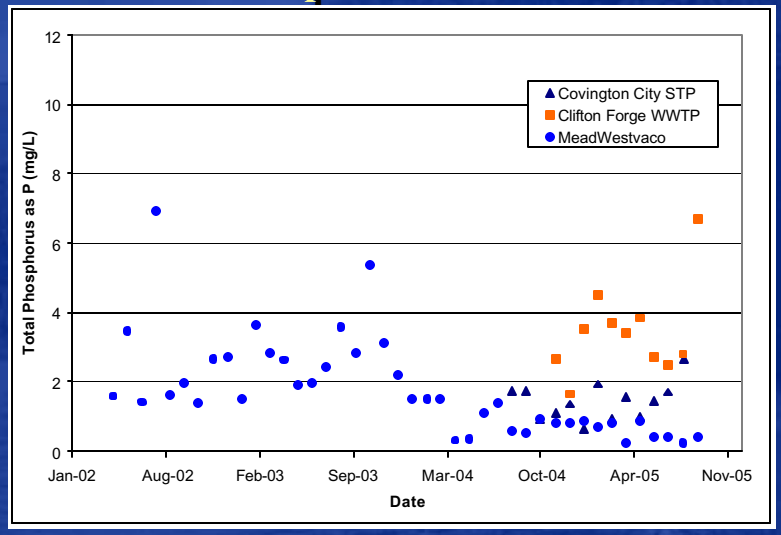
BOD5 Concentrations



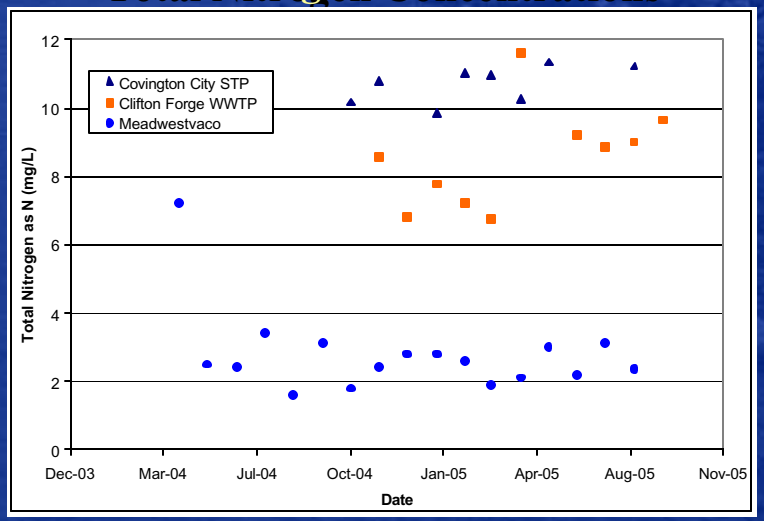
Phosphorous and Nitrogen Concentrations from Major Dischargers

The Jackson River is effluent-dominated under low flow conditions (when excessive periphyton growth and algal blooms are prone to occur), point sources appear to be the predominant source of the excessive nutrient loading

Total Phosphorus Concentrations



Total Nitrogen Concentrations



Permitted Facility Permit Limit Exceedances Summary

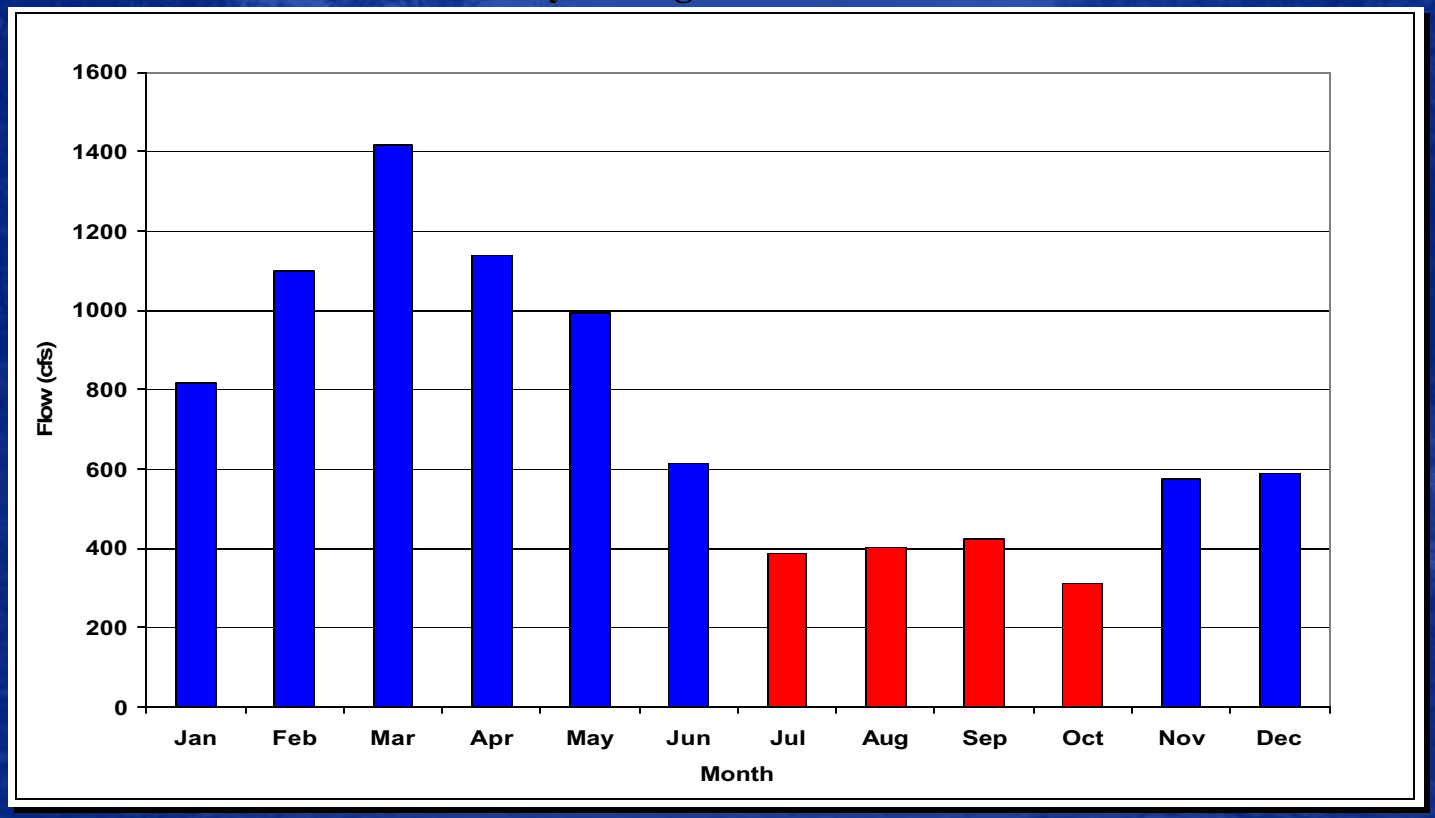
DMR Data indicates that some of the facilities exceeded their permitted levels. Mainly exceedances are in the following parameters:

- BOD5
- Chlorine
- Total suspended solids
- Temperature
- Flow
- Acute toxicity
- Petroleum hydrocarbons

Flow Modification

- The Jackson River stream flow is impacted by the flow releases from Gathright Dam
- A low-flow analysis at three stations on the Jackson River is presented to assess the critical low-flow conditions.

Flow Analysis in the Jackson River



- Streamflow data recorded from the period of 1984 to 2005 at the USGS Station 02013100 (City Playground)
- Indicates that the lowest monthly-average flows (1985-2004) occur during the months of July, August, September, and October.

Low-Flow Analysis

Weekly low-flow analysis was performed on the streamflow data at the City Playground Station

Consists of identifying the lowest weekly-average flow in the Jackson River for each year spanning the period of 1984 to 2005 and during the 4-month period (July, August, September and October)

Lowest weekly-average flow recorded is in October 2002 (189 cfs, October 4 to October 10).

Gathright Dam release consists of approximately 70 to 90 percent of the total flow at the City Playground Station

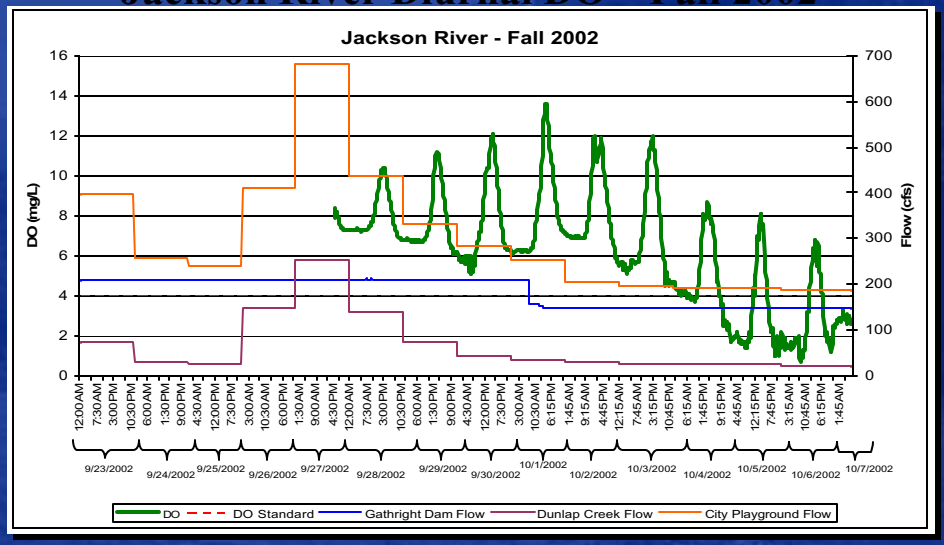
Year	Week	City Playground USGS 02013100 (cfs)	Gathright Dam USGS 02011800 (cfs)	Dunlap Creek USGS 02013000 (cfs)	% of Stream Flow from Gathright Release
1984	Oct 7 - Oct 13	241	179	36	74
1985	Oct 3 - Oct 10	204	149	19	73
1986	Oct 18 - Oct 24	202	178	21	88
1987	Sept 30 - Oct 6	222	179	29	81
1988	Oct 14 - Oct 20	192	172	17	90
1989	Oct 10 -Oct 16	393	224	87	57
1990	Oct 1 - Oct 7	214	186	16	87
1991	Oct 16 - Oct 22	244	198	19	81
1992	Oct 24 - Oct 30	238	191	33	80
1993	Oct 15 - Oct 21	217	199	22	92
1994	Oct 7 - Oct 13	213	189	22	89
1995	Oct 25- Oct 30	247	199	35	81
1996	Oct 3 - Oct 9	257	181	40	70
1997	Oct 5 - Oct 11	250	192	16	77
1998	Oct 25 - Oct 31	232	199	17	86
1999	Oct 25 - Oct 31	191	156	34	82
2000	Oct 3 - Oct 9	258	191	36	74
2001	Oct 3 - Oct 9	231	191	14	83
2002	Oct 4 - Oct 10	189	149	22	79
2003	Oct 7 - Oct 14	271	187	42	69
2004	Sept 1 – Sept 7	286	191	71	61
2005	Sept 30 - Oct 6	250	212	19	85

Low-Flow Conditions and DO Levels

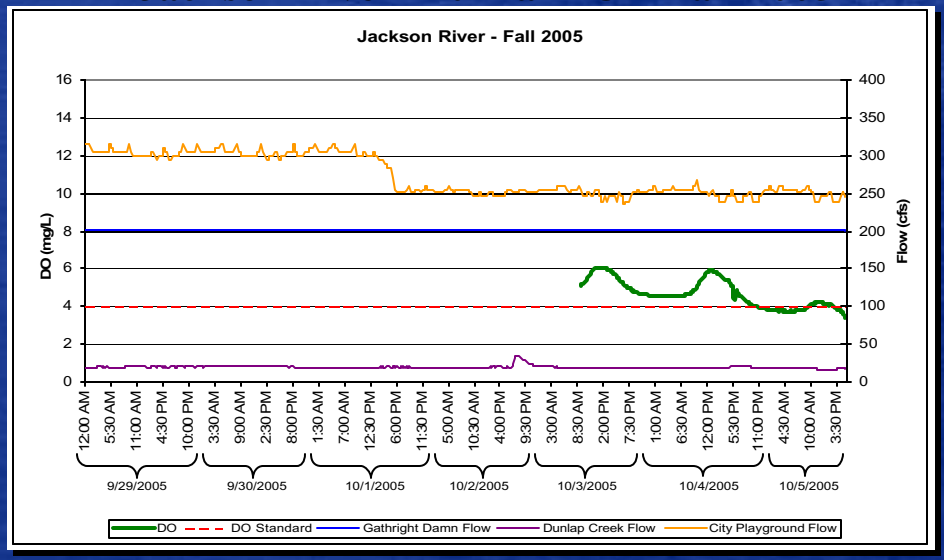
- Lowest weekly average flow on record (October 4 to October 10, 2002) coincides with the lowest observed diurnal dissolved oxygen concentration of 0.74 mg/L recorded on October 6, 2002
- Lowest weekly average flow on record also coincide with the largest diurnal Do fluctuations
- DO levels dropped below the minimum standard during the week of October 4 to October 5 2005. However, the DO violation in the fall of 2005 cannot be solely attributed to flow conditions

Therefore, low-flow condition is considered as a possible stressor to the benthic community in the Jackson River

Jackson River Diurnal DO – Fall 2002



Jackson River Diurnal DO – Fall 2005

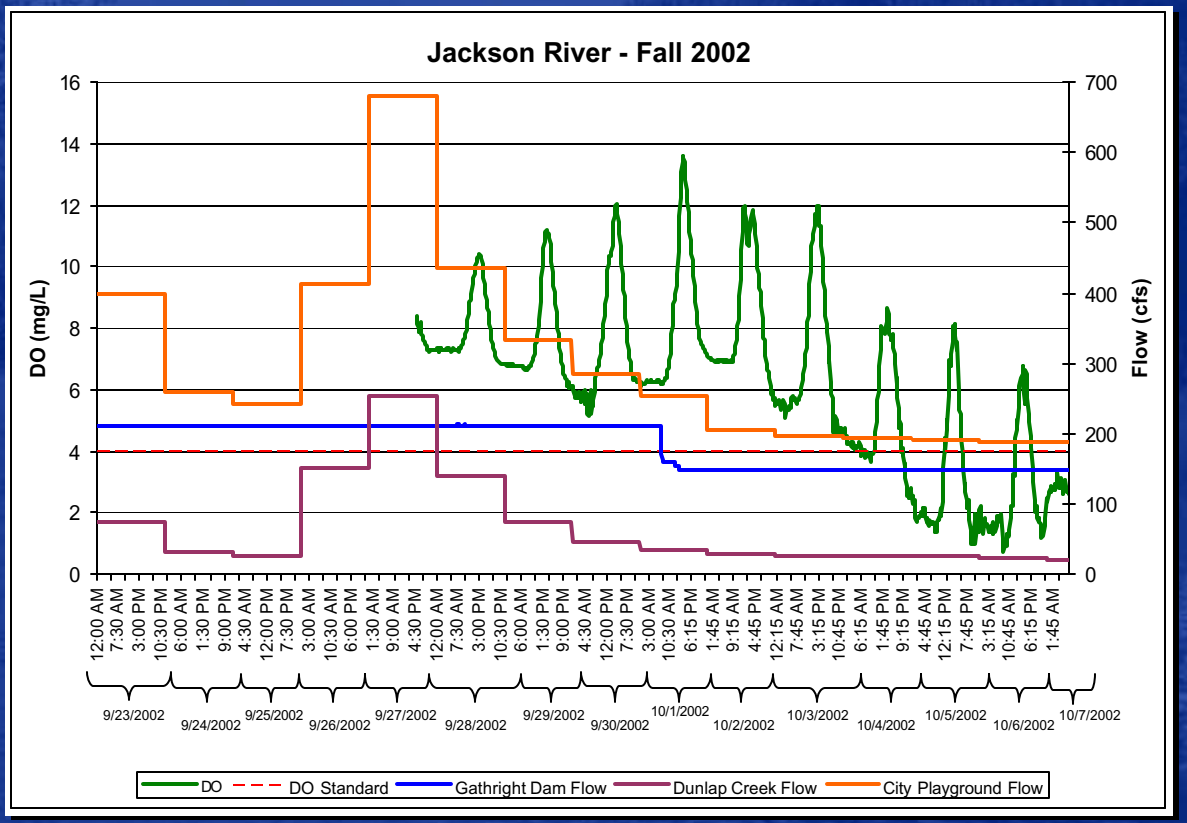


Wet-Weather Impacts on Low DO

Critical weekly low-flow period of October 4 to October 10, 2002 was preceded by a wet-weather event.

Flow at the City Playground station increased to 724 cfs on October 27, 2002 following a rainfall event of 1.90 inches recorded on October 26 at the Gathright Dam precipitation station.

Diurnal low DO might not be solely caused by the critical low flow experienced in the Jackson River. The wash off and re-suspension of oxygen demanding materials (organics) may have contributed to the low DO condition.



Therefore, wet-weather flow is considered as a possible stressor in the Jackson River

Stressor Identification Summary

- **Non Stressors**
  - Temperature and pH
  - Metals
  - Organics
  - Sediments
- **Possible Stressors**
  - TDS/Toxicity
  - Flow Modification
  - Wet Weather
- **Most Probable Stressors**
  - Low Dissolved Oxygen
  - Nutrients

Endpoint Identification

End-Point Stressor

- The common "end-point stressor" in the Jackson River is the low dissolved oxygen level.
- Excessive nutrient, accompanied with extreme low-flow, and episodic wet-weather events all contribute to cause the level of oxygen to fall below VADEQ standards.
- The dissolved oxygen issue would be addressed not only through a reduction in phosphorus loadings, but also by addressing the low-flow, and wet weather flow issues.

Next Steps

- Technical approach development
- End-points selection establishment
- Modeling option selection

Local TMDL Contacts

Department of Environmental Quality

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www.deq.virginia.gov

Reports/presentations available at:

www.deq.virginia.gov/tmdl/mtgppt.html

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